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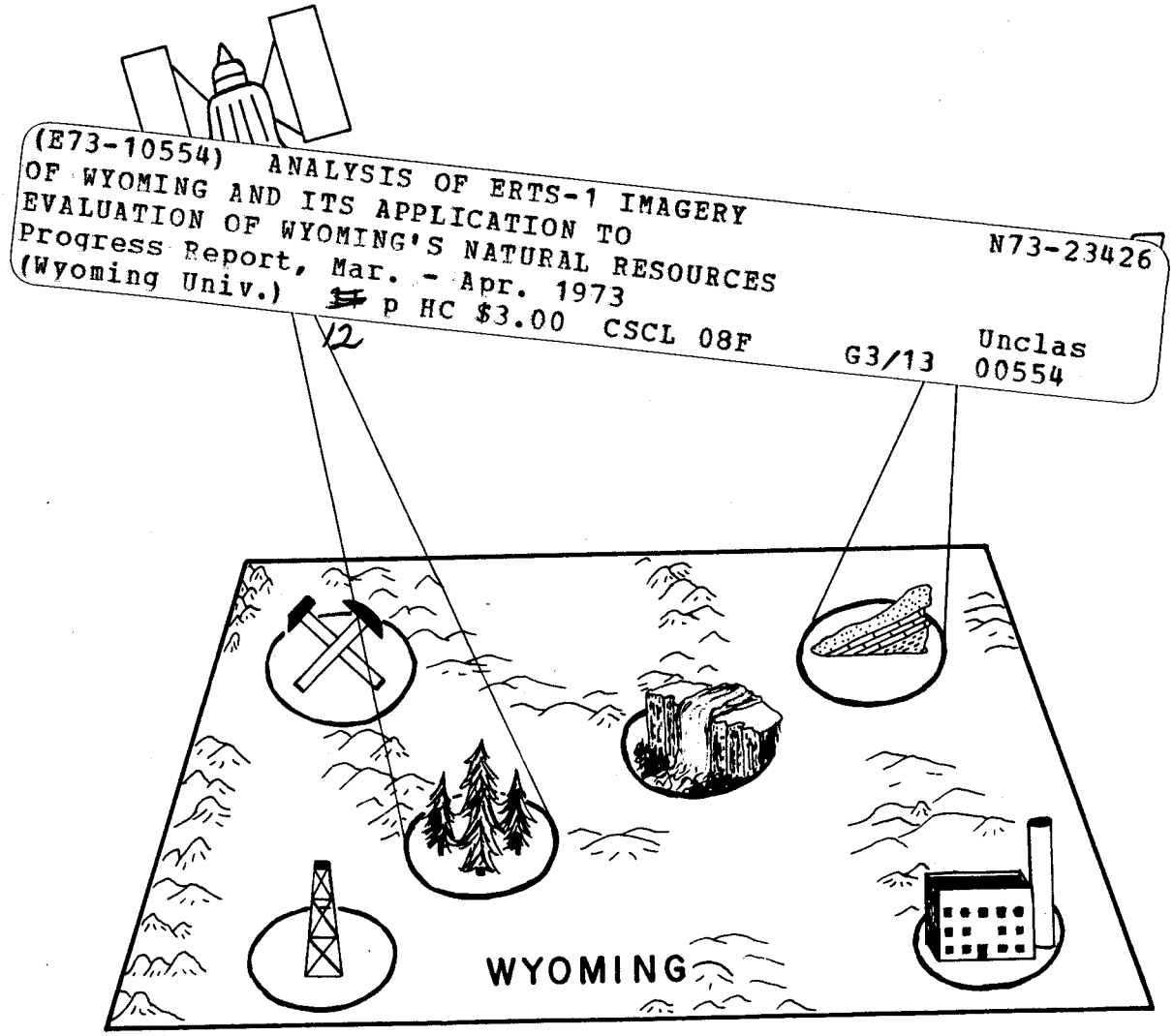

ANALYSIS OF ERTS-1 IMAGERY OF WYOMING AND ITS APPLICATION TO EVALUATION OF WYOMING'S NATURAL RESOURCES

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16. Abstract

The March-April report period saw a change in emphasis of the Wyoming ERTS-1 investigation from tests involving special-purpose and detailed studies in selected areas to broad-scale application of the image interpretations to real problems in hetereogeneous regions. Many special applications have not yet been completely tested, but the ERTS data has been successfully applied to many problems and the Wyoming investigators are now striving to test the scope of these applications in real situations. The broad-scale applications currently underway include geologic and land-use mapping. Programs to evaluate the ERTS imagery for mapping rangeland, soils and volcanic rocks for selected test areas are still in progress.

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Figure 2. Technical Report Standard Title Page

OBJECTIVES OF THE CONTRACT

The principal objective of the Wyoming ERTS-1 investigation is to apply the satellite imagery and supporting aircraft and ground-gathered data to the study of geological, botanical, agricultural, hydrological and cultural features in the state of Wyoming. The resulting information aids in the achievement of practical goals in inventory and management of natural resources.

WORK SUMMARY

The March-April report period was one of considerable change in test procedures of the Wyoming ERTS-1 investigations. Emphasis shifted from applications involving small- or intermediate-scale specific problems to broad-scale, general applications of the ERTS imagery. The change in emphasis reflects the realization of earlier goals which included determination of the utility of the ERTS-1 imagery in mapping of metavolcanic and metasedimentary rocks (Houston, 1973); glacial land forms (Breckenridge, 1973); fractures or lineaments (Parker, 1972); water impoundments, unstable areas, flood plains, crops, coniferous and deciduous forests, rangeland, slopes, soils, mines and urban areas (Breckenridge, Marrs, and Murphy, 1973). Early applications of ERTS imagery to these problems have demonstrated the considerable utility of the imagery and have allowed the investigators to optimize interpretive techniques and develop confidence in their interpretations. As a result of the success of these early tests, the Wyoming investigators are now involved in studies designed to establish the applicability of the ERTS-1 data to real problems. Rather than selecting certain, favorable areas for various tests, investigators are now using the ERTS imagery in broad,

heterogeneous regions. The image interpretations are aimed at real problems and are done in the proper scale and format to produce standard maps which are consistent in pattern and detail throughout each physiographic province.

Dr. R.S. Houston is presently making a geologic interpretation of the ERTS imagery for the area covered by the Army Map Service (AMS) 2-degree topographic map of the Arminto area. This 6,700-square-mile area (fig. 1, area 1) covers portions of the Bighorn, Powder River, and Wind River Basins and the southern end of the Bighorn Mountains. The physiography of the area varies markedly and the lithologies include crystalline basement rocks, complexly folded and faulted sedimentary units, and various unconsolidated surficial deposits. The 1:250,000-scale geologic map being constructed from image interpretations is color-keyed to the color and brightness values of the map unit as seen on the imagery. Consequently, it is possible to directly compare color patterns on the map with lithologies represented by distinctive hue and brightness values of the imagery regardless of their official stratigraphic classification. Considerable library research and field checking will be required to establish the validity of correlations between image presentation and lithologies, but already, several very strong and consistent patterns have been defined. For example, red-bed sequences are characteristically displayed in shades of yellow on the color-infrared composite imagery. Consistent correlation allows reliable identification of these particular lithologies from the image interpretation. Other image patterns may be similarly diagnostic and could prove of considerable value in identifying specific lithologies and their associated sequences from ERTS image interpretations. Another important facet of this work will be the comparison of the image-derived map with the 1:500,000-scale Wyoming Geologic

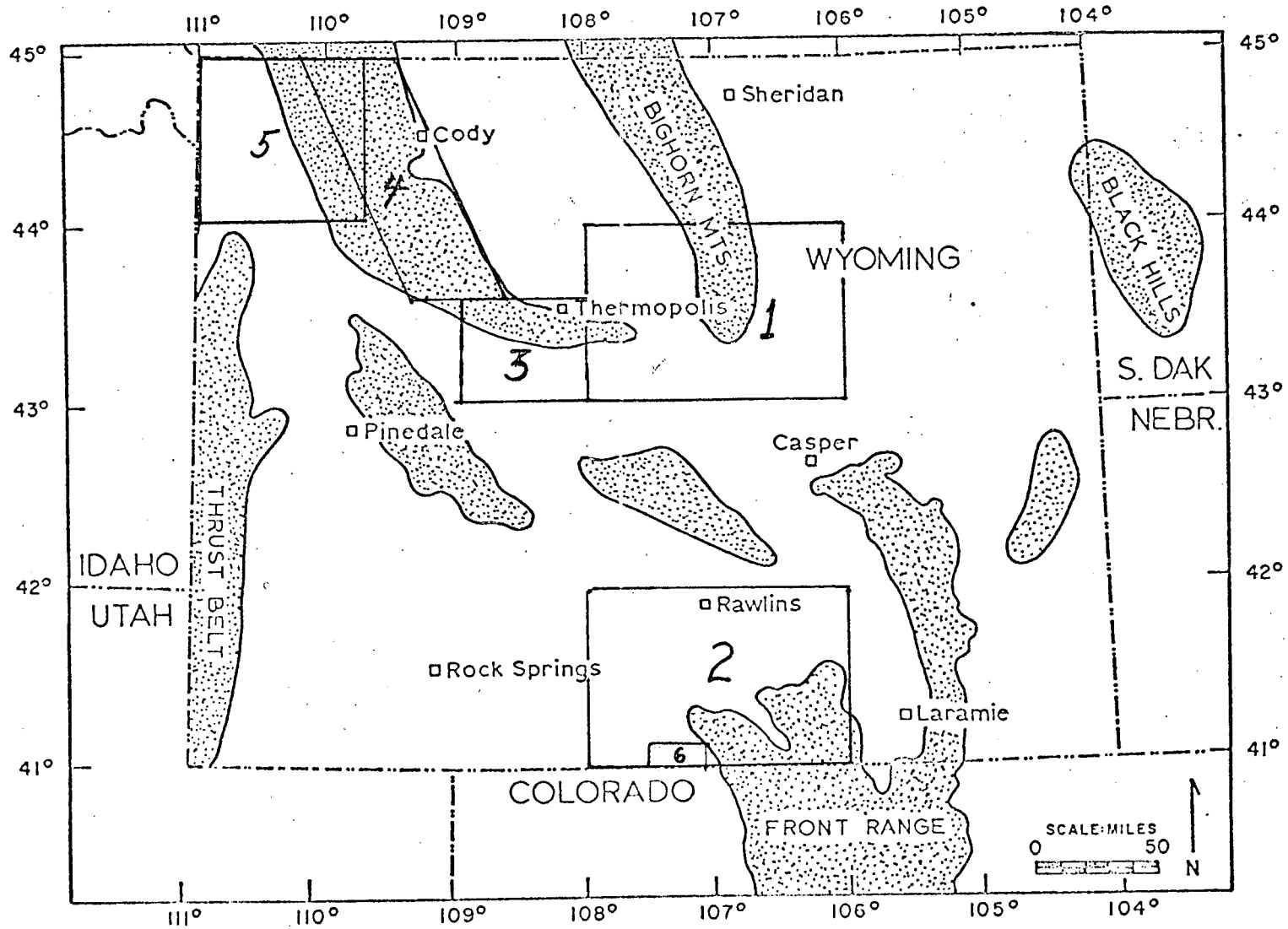

Figure 1. Index Map of Wyoming showing six areas currently under investigation.

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Map and with detailed geologic maps available for portions of the area. It is anticipated that the image-derived map (1:250,000) will lack much of the detail available from the detailed maps but should reveal some features not seen on the 1:500,000 state map. Thus, the interpretation should supply additional information in areas not mapped in detail.

Dr. R. W. Marrs is presently conducting a similar program in the Rawlins area of south-central Wyoming (Figure 1, Area 2). The 3000-square-mile study area lies between 41° and 42° north latitude and 106°30' and 108° west longitude. It includes large portions of the Washakie and Hanna Basins and the northern parts of the Sierra Madre and Medicine Bow Mountains. The study involves geologic, physiographic, and land-use mapping on a 1:250,000 scale. Physiographic and cultural features detected on the ERTS images are interpreted in various contexts to yield a suite of multipurpose maps displaying broad-scale information about agriculture, soils, slopes, natural vegetation, surface water and geology.

Dr. Marrs is also using a color coding technique to expedite correlation of similar features and areas across the region and to permit definition of those features that prove significant and show a characteristic response on the imagery.

In addition to these studies involving general applications, work is continuing to define the applicability of the ERTS-1 imagery to several specific problems.

A study area near Riverton (Fig. 1, Area 3) has been chosen for evaluating the usefulness of ERTS-1 in delineating soil types in that region. The Riverton area has recently been mapped in detail on a large-scale photographic base by the Soil Conservation Service. Missions 184 and 213 provide excellent

low-level coverage of most of the area. A previous attempt to map soils in the Powder River Basin (Breckenridge, Marrs and Murphy, 1973) was successful on a large scale. In the Powder River Basin the soil types were mapped using the substrata to anticipate the weathering products and thus the related soil type. The Riverton area has better developed soils and extensive agricultural development. The present soil classification (the 7th Approximation, U.S.D.A. is not directly applicable to remotely sensed data. We have, however, noted that a number of pedologic factors can be recognized such as soil moisture, vegetation, color, slope, elevation, etc. Detailed spectral measurements will be made in the field this summer on known units in order to compare with the imagery. Perhaps a remote sensing soil classification can be developed.

A study to evaluate the usefulness of ERTS imagery with respect to volcanic lithologies and structure in the Absaroka Volcanic Field is continuing (Fig. 1, Area 4). Preliminary maps from U-2, color-infrared imagery indicate a correlation between dikes, fracture zones, and mineralized areas. Final assessment of this relationship must be deferred until field checks can be made. The U-2 imagery seems superior to both ERTS imagery and low-level aircraft in studying regional facies changes in the volcanics.

A test is in progress (Fig. 1, Area 5) to compare the terrain mapping capability of the isodensitracer with computer generated maps of Yellowstone National Park (Thompson, 1973). Preliminary results show that the computer chosen classes can be easily reproduced on the isodensitracings. As yet we have not attempted to subdivide the original classes but the single-pen tracings indicate much more detail can be resolved within each class.

Work in the Baggs, Wyoming test site (Fig. 1, Area 6) which concerns the application of ERTS-1 imagery to detailed rangeland mapping has continued throughout the report period. The major effort has been in preparation for the summer field session in which an array of meteorological instuments will be set out to allow weather changes to be monitored and related to changes in the growth patterns of the vegetation. These, in turn, will be used to evaluate interpretations of the ERTS images obtained at different times throughout the year.

SIGNIFICANT RESULTS

None for this report period.

CONFORMANCE WITH WORK SCHEDULE

Phase III of the Wyoming ERTS-1 investigation is continuing on schedule. Planned work during the upcoming field season should allow completion of several studies which presently lack only field verification. Other programs, particularly those requiring seasonal information, will require extended field studies that will not be complete till late autumn.

DISCUSSION OF PROBLEMS

The most severe restriction presently affecting the Wyoming program is the continuing lack of snow-free and cloud-free coverage of some test areas. We have yet to receive images adequate for the geology and forestry studies in the Medicine Bow and Sierra Madre ranges. Other studies suffering from lack of data are those requiring repetitive coverage during the growing season. It is anticipated that these problems will be largely alleviated as imagery is acquired during the May-August period. However, we still desire the back-ordered coverage for September 7-12, 1972. This image sequence was requested in November and December 1972 and has not yet been received.

The photointerpretive equipment which was out of service in February and March, 1973 has been repaired and is again functioning properly.

ADEQUACY OF FUNDS

Expenditures continued within budgeted limits for the March-April report period. In fact, a slight surplus has developed in the categories of part-time labor and travel. The accumulation of budgeted labor funds resulted from the delay in locating a suitable graduate assistant in plant science and from Mr. Redfern's departure from the program. However, the contract objectives will require additional effort in botany and plant science and the accumulated funds will be needed to support this effort. In order to accomplish the contract objectives, we intend to employ a part-time technical assistant to handle routine maintenance, equipment operation and data handling, thus allowing the investigators more research time. Also we plan to employ Mr. Gordon (the plant-science research assistant) for an additional month this summer. This additional effort will absorb the accumulated funds.

The apparent surplus in travel funds is a result in the delayed launch and data dissemination experienced last summer. These delays forced most of the investigators to postpone field work scheduled for summer, 1972. This work remains to be done and has been added to the work load for summer, 1973. Consequently, a great deal more work than originally planned is scheduled for this summer and the cost will be correspondingly increased.

PERSONNEL

No personnel changes were made during the March-April report period. However, several additions to the part-time staff are anticipated in June. In addition to the technical assistant mentioned above, a part-time graduate assistant in Botany will be hired to replace Mr. Redfern and a much-needed

graduate assistant in geology will be added to the program. Both graduate assistant positions are budgeted.

PLANNED WORK FOR NEXT REPORT PERIOD

Work scheduled for the May-June report period includes:

1. Continuing analysis of the ERTS-1 imagery of the six areas outlined on the index map (Fig. 1) and initial field checks of the resultant maps.
2. Field checking of the vegetation map of the Laramie mountains area compiled by Mr. Redfern and completion of the report.
3. Field checks to substantiate interpretations of certain features noted in previously reported work.
4. Collection of ground truth data in conjunction with selected ERTS overpasses and a joint ERTS/Skylab aircraft support flight scheduled for June, 1973.

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